



# Alternative Energy as an Engagement Opportunity in the USPACOM AOR



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# Palau PV Energy Information Brief Overview

- (U) Purpose
- (U) Background
- (U) Status
- (U) Issues
- (U) Way Ahead





# Purpose of this Presentation

To raise awareness of USPACOM efforts to further develop Photo-Voltaic energy in the nation of Palau, in partnership with:

- ODUSD(I&E) Defense Environmental International Cooperation Program (DEIC)
- US Army Corps of Engineers 249th “Prime Power” Engineering Battalion
- Palau Commonwealth Improvement Program
- Palau Energy Office
- Palau Public Utility Corporation
- Palau Development Bank
- Dr. Herbert Wade, School of Renewable Energy Technology (SERT), Thailand.



[www.sert.nu.ac.th](http://www.sert.nu.ac.th)



# What does PACOM have to do with PV power?

The U.S. Pacific Command was established as a unified command on January 1, 1947. PACOM is the oldest and largest of the United States' unified commands.

## VISION

U.S. Pacific Command will be an engaged and trusted partner committed to preserving the security, stability, and freedom upon which enduring prosperity in the Asia-Pacific region depends.

## MISSION

U.S. Pacific Command protects and defends, in concert with other U.S. Government agencies, the territory of the United States, its people, and its interests.

With allies and partners, U.S. Pacific Command is committed to enhancing stability in the Asia-Pacific region by promoting security cooperation, encouraging peaceful development, responding to contingencies, deterring aggression, and, when necessary, fighting to win.



# History of Pacific Solar Power

- USDOE Territorial Energy Assessment (1982)
  - RESULTS: a few homes in SW Palau islands get 33Wp panel/lights
- IAEA/Pacific Power Association Multi-island utility-renewable energy surveys (2006) RESULTS:
  - 225 kWp grid connected solar in Palau
  - Initiation of financial incentives in Palau for solar water heating



***100kW System at Capitol Building  
on the island of Babeldaob,  
Palau***



***125kW system installed at  
the hospital on the island  
of Koror, Palau***

# Overview of Palau

- Under UN/US Trusteeship until 1994
- Now a Sovereign nation with government structure similar to USA
- Palau has no military and relies on USA for defense.
- Palauan citizens may volunteer for service in the U.S. Armed Forces
- *Population* : 21,100.
- *GNP*: U.S.\$8,806 per capita.

The Palau Public Utilities Corporation (PPUC) is responsible for electricity supply to all consumers in Palau.

Capacity :

- 31MW main islands,
- 2.7MW outer islands





# Background - Palau Civic Action Team (CAT)

**USPACOM has continuously operated a CAT Detachment on Palau since 1968**

**CAT mission is three-fold:**

- Provide a continuous favorable U.S. military presence
- Transfer technical skills to local residents
- Partner with Palau in basic infrastructure development

**Accomplished through four execution elements:**

- Community Construction Program
  - Provide construction support to the host nation
  - Apprentice Training Program
  - Assist and train Palauans in general engineering skills
- Medical Civic Action Program (MEDCAP)
  - Provide an in-camp clinic, outreach to outlying areas, and health education programs for local residents
- Community Relations Program (COMREL)
  - Provide a positive U.S. presence
  - Technical Assists





# Background – Palau DEIC Mission

September 2009 –  
**USPACOM proposal to deploy PV power  
at Camp Katuu selected by DEIC program.**



## Palau DEIC Project Mission Statement

In order to deepen US ties, strengthen alignment, and expand innovative solutions to energy challenges, USPACOM will install a photo-voltaic array at Camp Katuu, Palau in support of the Civic Action Team (CAT) detachment no later than 30 Sept 2010.

This alternative energy source will set an example to other small nations in a region of the world heavily dependent on foreign fossil fuels for electricity generation.



# Palau DEIC Project Objectives

- Reduce the operating cost for Camp Katuu by lowering electrical costs (currently 25% of overhead)
- Train the 249<sup>th</sup> Engineering Battalion on an emerging technology
- Accomplishes cost savings by meshing with the host nation's renewable energy plans with PV as the featured technology.
- Stabilizes the national grid with fungible power the PUC can manage
- Strengthen US image as a contributing partner in Palau's economy
- Provide a showpiece within the Pacific for other island nations to visit and emulate
- Provide USPACOM an engagement activity with a small nation through technological stabilization of critical national infrastructures.
- Networking with Dr. Wade who can act as an independent advocate for USPACOM's partnership development within the AOR.
- Strengthen the DEIC Program in the USPACOM AOR



# Palau DEIC Project Status

## Phase 1 Base Camp Survey (Nov 2009) – USACE 249<sup>th</sup> Prime Power BN and Dr. Herbert Wade.



- Findings:
  - Total Peak Load: 43kW @ 1100hrs 8NOV2009
  - 3 x 60 kW Generators on Site: one is more than adequate
- Recommendations:
  - paint rooftops with aluminum spray
  - install awnings; replace windows with Low-E type windows
  - replace window A/C units with power efficient split units
  - fabricate shaded covers for A/C condenser units
  - replace washing machines with power efficient front loaders
  - remove A/C from laundry room; replace electric dryers with bottled gas units
  - replace electric range with bottle gas range
  - consolidate freezer contents and unplug units not in long term use



# Palau DEIC Project Status

## Phase 2 Camp Katuu Alternative Energy Study (Nov 2009) – USACE 249<sup>th</sup> Prime Power BN and Dr. Herbert Wade.



### Determination:

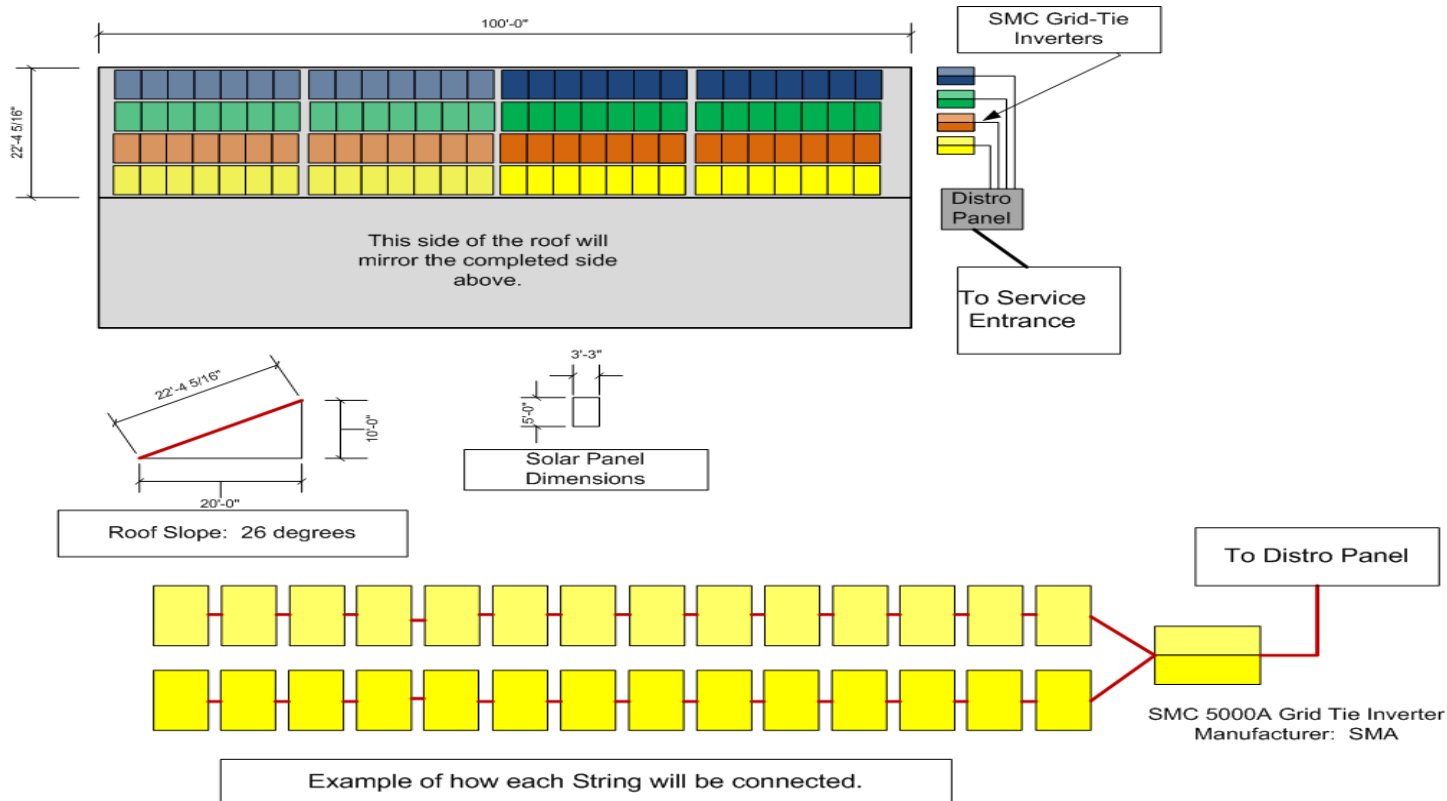
- Feasible to install a PV system that can provide 30kW to 60kW usable power for Camp Katuu. Excess power would put into the grid via net-metering.
- Execution possible by a trained 249<sup>th</sup> Engineer Battalion, Prime Power Section (7 Soldiers) estimated 14-day duration. (Additional Training will be required).





# Palau DEIC Project Status

## Details of proposed PV array – Katuu Builder's Shop Roof





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# Palau DEIC Project Issues

- The Builder's shop roof requires structural upgrades in order to accommodate the PV load.
- The Prime Power soldiers are not fully trained in alternative energy installation.
- Manufacturers typically expect certified or pre-qualified contractors to install equipment for warranty protection.
- Maintenance responsibilities undefined.



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# Palau DEIC Way Ahead

- Camp Katuu will undertake the Builder's shop roof upgrades this summer.
- Prime Power soldiers plan to take third party training in alternative energy/PV installation and inspection this summer (pending final DEIC fund approval).
- Prime Power conducting industry outreach to ascertain alternatives to sustain warranty protection. Have budgeted to fund a manufacturer's A/QC rep to be on site during installation.
- Camp Katuu CAT developing strategic communications plan



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# Palau DEIC Project Desired End State

- Camp Katuu will mesh with the net-metering system and receive credit for the electrical power the CAT supplies the grid.
- This power source will also help stabilize the grid during peak hours.
- The camp will benefit since the grid will act as storage, relieving an on-site battery system requirement.





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# BACKUP SLIDES





# Defense Environmental International Cooperation Program

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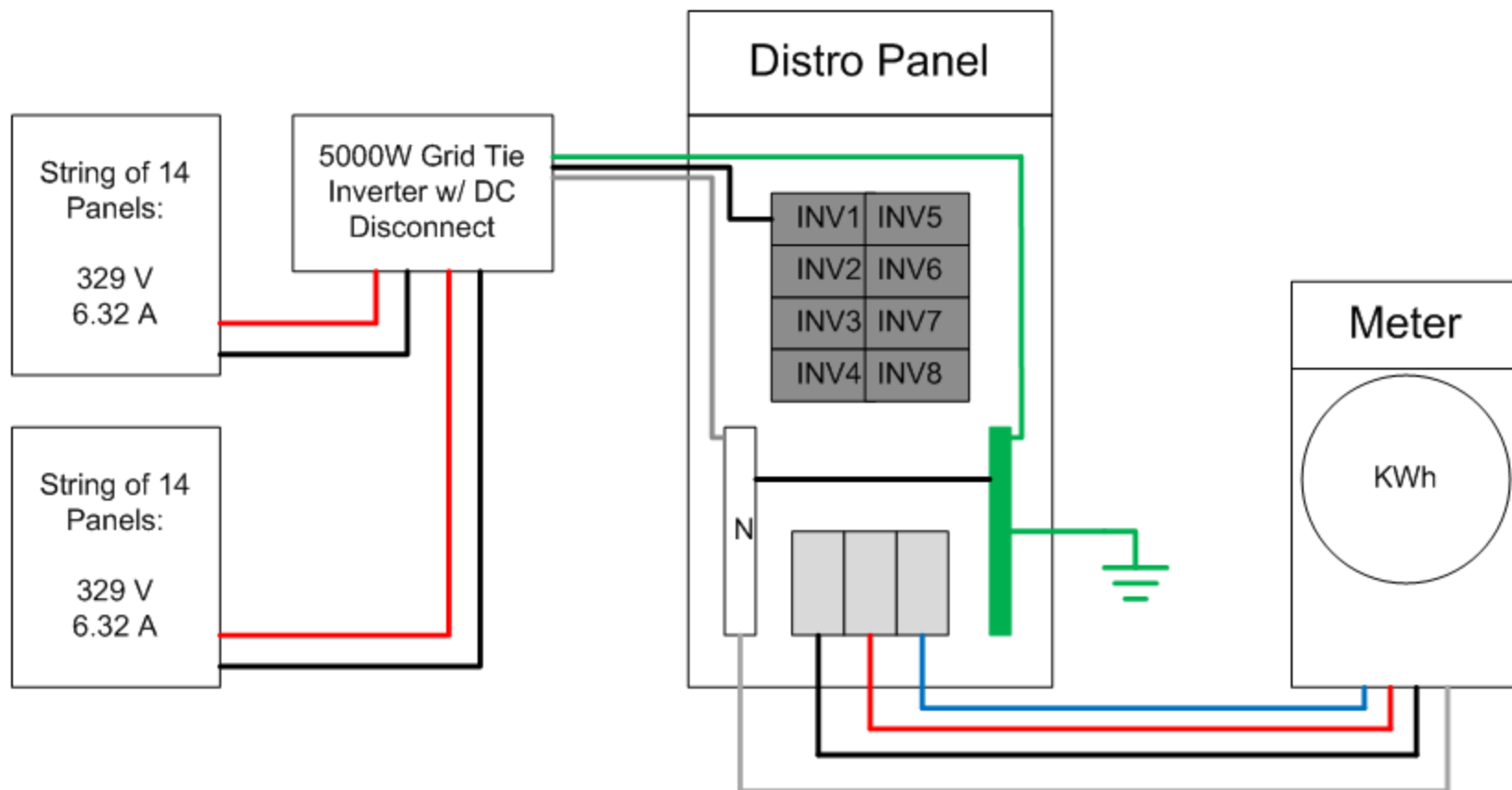
The Office of the Deputy Under Secretary of Defense (Installations and Environment) (ODUSD(I&E)), in partnership with the Office of the Under Secretary of Defense (Policy) and regional Combatant Commanders, uses the Defense Environmental International Cooperation (DEIC) Program as an effective and cost efficient way to:

- share environmental information;
- counter the proliferation of weapons of mass destruction;
- partner to maintain access to resources for training and readiness;
- contribute to interoperability;
- promote regional cooperation;
- foster a global military environmental ethic; and
- improve interagency processes, focus, and integration.

DEIC activities focus on building capacity to mitigate encroachment; preserve training range capabilities; and enhance regional capacity to address natural, accidental, or terrorist caused disasters.



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## GRID TIE INVERTER

SMC 5000A Grid Tie Inverter w/ DC  
Disconnect  
Manufacturer: SMA

2 Strings of 16 panels each are  
paralleled into the Inverter.

AC cabling then connects Inverters to  
"Solar Distribution Panel"



Input (DC)	
Max. DC power	5750 W
Max. DC voltage	600 V
PV-voltage range, MPPT	246 V - 480 V
Max. input current	26 A
Number of MPP trackers	1
Max. number of strings (parallel)	4
Output (AC)	
Nominal AC output	5000 W
Max. AC power	5500 W
Max. output current	26 A
Nominal AC voltage / range	220 V - 240 V / 180 V - 260 V
AC grid frequency (self-adjusting) / range	50 Hz / 60 Hz / $\pm 4.5$ Hz
Phase shift ( $\cos \phi$ )	1
AC connection / Power balancing	single-phase / ●
Efficiency	
Max. efficiency	96.1 %
Euro-Eta	95.2 %

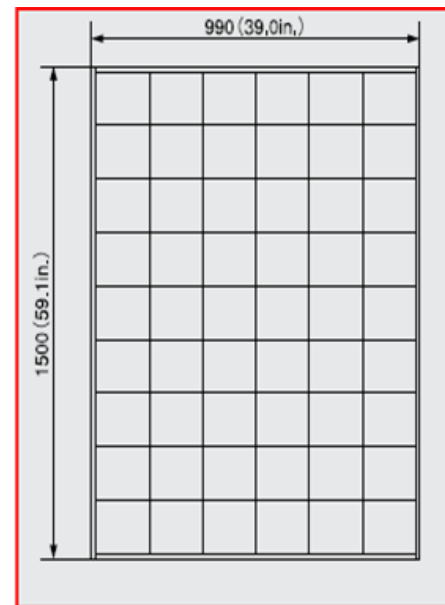
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# SOLAR PANEL

210W Solar Panel  
 Manufacturer: Kyocera  
 Model: KD210-GX-LP

2 Strings of Solar panels each consisting of 16 panels will be connected in Parallel resulting in the following output::

376 Volts  
 12.64 Amps  
 4752 Watts



## Specifications

### Electrical Performance under Standard Test Conditions (\*STC)

Maximum Power (P <sub>max</sub> )	210W (+5%/−5%)
Maximum Power Voltage (V <sub>mpp</sub> )	26.6V
Maximum Power Current (I <sub>mp</sub> )	7.90A
Open Circuit Voltage (V <sub>oc</sub> )	33.2V
Short Circuit Current (I <sub>sc</sub> )	8.58A
Max System Voltage	600V
Temperature Coefficient of V <sub>oc</sub>	−1.20×10 <sup>−1</sup> V/°C
Temperature Coefficient of I <sub>sc</sub>	5.15×10 <sup>−3</sup> A/°C

\*STC : Irradiance 1000W/m<sup>2</sup>, AM1.5 spectrum, cell temperature 25°C

### Electrical Performance at 800W/m<sup>2</sup>, \*NOCT, AM1.5

Maximum Power (P <sub>max</sub> )	148W
Maximum Power Voltage (V <sub>mpp</sub> )	23.5V
Maximum Power Current (I <sub>mp</sub> )	6.32A
Open Circuit Voltage (V <sub>oc</sub> )	29.9V
Short Circuit Current (I <sub>sc</sub> )	6.98A

\*NOCT (Nominal Operating Cell Temperature) : 49°C

### Cells

Number per Module	54
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### Module Characteristics

Length × Width × Depth	1500mm(59.1in.)×990mm(39.0in.)×38mm(1.4in.)
Weight	18.5kg(40.8lbs.)
Cable	(+)760mm(29.9in.), (−)1840mm(72.4in.)

### Junction Box Characteristics

Length × Width × Depth	100mm(3.9in.)×108mm(4.3in.)×15mm(0.6in.)
IP Code	IP65

### Others

*Operating Temperature	−40°C~90°C
Maximum Fuse	15A

\*This temperature is based on cell temperature.